



National Aeronautics and
Space Administration

Educational Product

Teachers

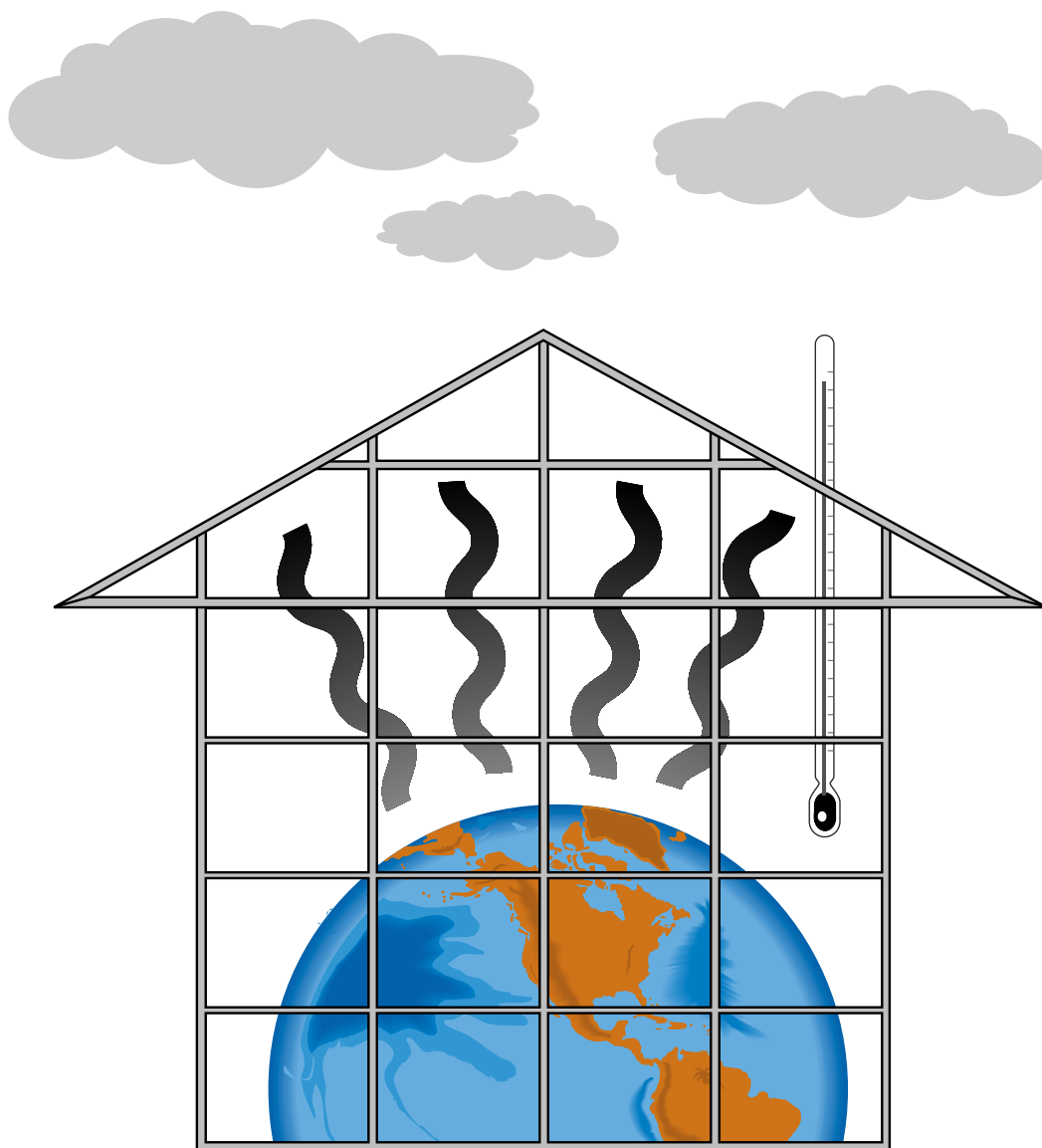
Grades 5-8

LaRC



ELECTRONIC LESSON:
THE HEAT IS ON

OEd



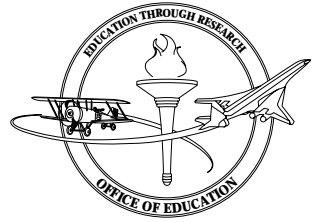


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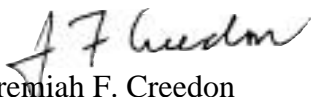
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NASA Langley's National Engineers Week project, now in its seventh year, is an example of the Center's commitment to mathematics and science education and to community outreach. We have a responsibility to encourage and help our young people prepare for life in a technological world and help develop the work force of the future. Providing positive role models is an effective way to capture the interest of students. One way we reach students is in the classroom, with personal visits from our staff. Of course, there are not enough of us to visit as many classrooms as we would like, so alternate methods of sharing the value of a mathematics and science education, as well as good communication skills, are also needed to help us reach as many students as possible.

"CONNECT" is one alternative mechanism for reaching out to the students, especially those we cannot visit personally during National Engineers Week. During the month of February, three 30-minute electronic lessons created by Langley will be distributed through WHRO-TV's ITFS wireless system to school cable networks. Each lesson will target a different group of grades (K-4, 5-8, and 9-12) and will address specific mathematics and science Virginia Standards of Learning (SOL).

The program, which launches Langley's Distance Learning Initiatives, shows the connection between mathematics and science skills taught in the classroom and their application in the workplace. In addition, the lessons show how science, mathematics, and engineering relate to the world around the students and why their studies are important. These lessons will be distributed to school systems on Wednesdays at 10:30 a.m., beginning February 12. The lessons will be rebroadcast on Fridays at the same time.

The Engineers Week program is the single largest outreach effort sponsored by NASA Langley. Last year, 170 employees participated reaching over 24,000 students and teachers within 12 school districts in the Tidewater area. With the introduction of Langley's distance learning programming, and with the collaboration of WHRO, students and teachers from 19 school divisions in Southeastern Virginia and Northeastern North Carolina will be reached.


Jeremiah F. Creedon
Director

LETTER
From NASA Langley's
Director of Education



Project Direction

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Special Thanks

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Pete Thomas
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NASA Headquarters Aeronautics
Program Office

NASA Headquarters Office of
Human Resources & Education

Dear Educator:

As one of its four Strategic Outcomes, NASA has accepted the goal of promoting "the pursuit of educational excellence." NASA's vision for education is set forth in the 1996 NASA Strategic Plan:

To promote the pursuit of educational excellence by involving "the educational community in our endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds."

The program CONNECT marks the beginning of NASA Langley's distance learning initiatives. It is the goal of Langley's Office of Education to use distance learning media to communicate and disseminate to the educational community instructional programs and materials from NASA's mission to promote excellence in mathematics, science, and technology education.

I sincerely hope you and your students enjoy the video and activities included with each electronic lesson. I invite you to provide us with feedback about this program and any of our other educational products. Included in this guide is an evaluation form. Please take a moment to complete the form and return to us. We will gladly send you some of our outstanding materials, grade level appropriate, upon receipt of your evaluation form.

Sincerely,

Samuel E. Massenberg, Ed.D.
Director, Office of Education
NASA Langley Research Center

THE GREENHOUSE EFFECT

Lesson Title:

The Heat Is On

Airs on WHRO ITFS, Channels 3, 25, 35

February 19, 1997, 10:30 a.m.

Rebroadcast of lesson on February 21,

10:30 a.m.

Subject Area Focus:

science

Science Standards:

Science as Inquiry

Physical Science

-properties of objects and materials

Unifying Concepts and Processes

-change, constancy, and measurement

Mathematics Standards:

Problem Solving

Reasoning

Measurement

Virginia Standards of Learning:

Science, PS.1: The student will

plan and conduct investigations in which temperature is accurately

measured and reported using

the International Systems of

Units (SI-metric), thermometers

are used to gather data, research

skills are utilized using a variety of

resources, data from experiments

are recorded and interpreted from

line graphs, and valid conclusions

are made after analyzing data.

Program Description:

Students have posed many questions regarding whether the Earth's climate is changing and getting hotter. This thought-provoking program explores the greenhouse effect, which is the warming of climate that results when the atmosphere traps heat radiating from Earth out to space. The students are taken on a field trip to the lab of a research scientist to learn how gases in the Earth's atmosphere trap heat in the same manner as the

glass in a greenhouse. The program provides an opportunity for students to conduct an investigation related to NASA's Mission to Planet Earth (MTPE) Enterprise.

The lesson uses a greenhouse and a simple experiment for students to make connections to real world applications of NASA's MTPE Enterprise. MTPE is one of four research enterprises which have been established by NASA to implement and communicate its mission to the public. The MTPE Enterprise seeks to answer some difficult questions which specifically relate to environmental change.

An important part of the lesson is the **Enterprise Challenge**. Students will have four minutes to complete the challenge. They will watch an experiment being conducted and collect and make a graph of the data. Students will analyze the data to make real world connections between the experimental situation and the greenhouse effect on Earth.

Before Watching

1. Discuss with students whether the Earth's climate is changing and ask them to give reasons to justify their answers.
2. Reproduce the blank data table and graph forms for students or instruct students to copy the data table and graph forms onto a sheet of notebook paper.
3. Review with students how to make a line graph from a data table.

After Watching

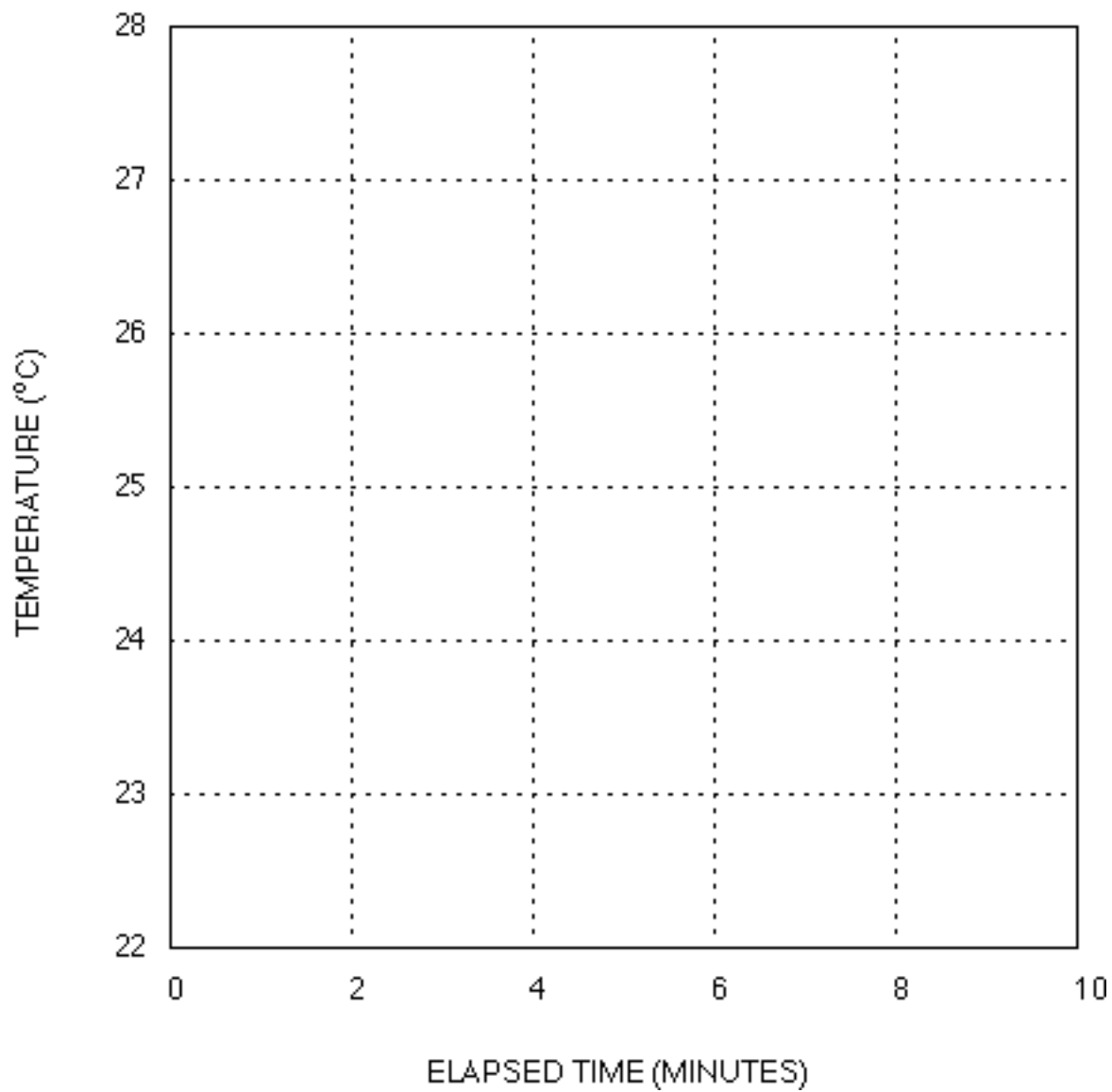
1. Repeat the Enterprise Challenge experiment changing some condition (e.g., higher wattage lamp, different water depth).
2. Let students pick a career. Ask them to write a story in the form of an autobiography about how their career could help improve knowledge of Earth or life on Earth.
3. Discuss with students how a temperature change of a few degrees could drastically change our world. Consider the impact on coastal areas and inland cities.

Enterprise Challenge

1. Make a line graph of the data.
2. Compare the two lines.
3. Why are they different?

ENTERPRISE CHALLENGE DATA GRAPH

○ T1 ● T2



ENTERPRISE CHALLENGE EXPERIMENT

Objective: The student will be able to recognize that water absorbs invisible infrared radiation.

Materials

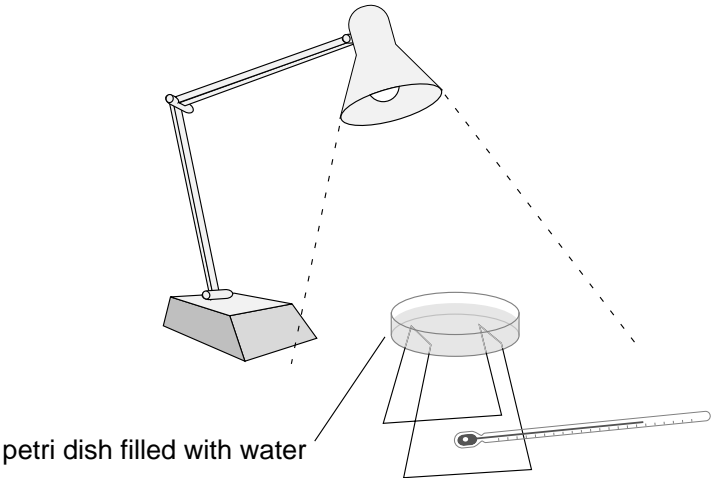
- 2 identical desk lamps (60 watt or higher)
- 2 identical thermometers (Celsius scale preferred)
- Petri dish or similar shallow transparent container
- black plastic tape or black paper with transparent tape
- 2 supports (1 to 2 cm high) for the dish (small blocks or memo pads work well)
- ruler
- tap water at room temperature
- clock or watch

Procedure

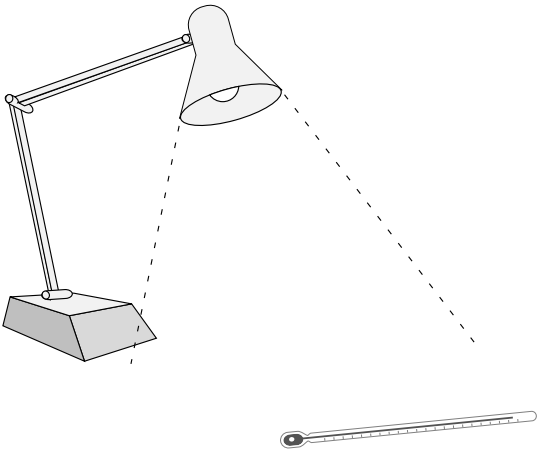
1. Label one thermometer "T1" and the other "T2".
2. Cover each thermometer bulb with black material.
3. Set each thermometer horizontally on the table so that the bulb is centered under the desk lamp.
4. Make sure both lamp bulbs are at the same distance (at least 15 cm) from the tabletop.
5. Place supports on either side of thermometer T1 so that the dish can be supported above the thermometer bulb.
6. Place the dish on the supports so that the thermometer bulb is near the center. Make sure the thermometer bulb is not touching the bottom of the dish.
7. Fill the dish with room-temperature tap water to a depth of about 1 cm.
8. Record the room temperature as measured by each thermometer.
9. Turn on both lamps at the same time. Record the temperature of both thermometers every two minutes for a total of 10 minutes.
10. Make a line graph of the results. Use different symbols for the data from each thermometer (for example, an open circle for T1 and a solid circle for T2).
11. Draw lines to connect the symbols for each thermometer.
12. Explain the difference between the lines for T1 and T2.

ENTERPRISE CHALLENGE EXPERIMENT SET-UP

T1



T2



ENTERPRISE CHALLENGE DATA TABLE

ELAPSED TIME (MINUTES)	TEMPERATURE T1 (°C)	TEMPERATURE T2 (°C)
0		
2		
4		
6		
8		
10		

What's really happening...

IN THE ENTERPRISE CHALLENGE EXPERIMENT

A shallow layer of pure water is transparent to visible radiation (the light we humans can see), but this does not mean that it is transparent to invisible radiation. Our eyes cannot see invisible radiation any more than our ears can hear a high-pitched dog whistle.

The light bulbs give off both visible radiation and invisible infrared radiation. When infrared radiation is absorbed by an object (like the blackened thermometer bulb), the object heats up. The dish of water absorbed most of the lamp's infrared radiation before it could reach thermometer T1 (but allowed the visible radiation to pass through), so the temperature of T1 did not rise as much as that of T2.

Some gases in the Earth's atmosphere act like the dish of water in this experiment. The gases absorb infrared radiation coming from the Earth's surface. This causes the atmosphere to heat up and the heat comes back to the Earth's surface in many different ways. This process is called the atmospheric greenhouse effect. The gases that are good absorbers of infrared radiation are called greenhouse gases. Global warming is what we expect to happen because human activities are releasing more and more greenhouse gases into the atmosphere.

NASA Educational Resources

The NASA Education Home Page is the entry point for a concise, user-friendly way to learn all about NASA's education programs, products, and services. The page contains:

- a "scrolling line" area for hot topics, application deadlines, and other announcements.
- a brief overview of NASA's Education Program.
- on-line access to current educational information and instructional resource materials.
- information about programs and curriculum support products including a searchable inventory of programs and how to access instructional resource materials and services.
- education points of contact for NASA Headquarters as well as NASA Field Centers.

World Wide Web:

<http://www.hq.nasa.gov/office/codef/education/>

NASA Educational Satellite Videoconference Series is offered as an inservice education program for educators through the school year. The content of each program varies, but includes aeronautics or space science topics of interest to elementary and secondary teachers. NASA program managers, scientists, astronauts, and education specialists are featured presenters. The videoconference series is free to registered educational institutions. To participate, the institution must have a C-band satellite receiving system, teacher release time, and an optional long distance telephone line for

interaction. Arrangements may also be made to receive the satellite signal through the local cable television system. The programs may be videotaped and copied for later use.

For more information, contact:

Videoconference Producer
NASA Teaching From Space Program
308 A CITD

Oklahoma State University
Stillwater, OK 74078-0422

or send an electronic message (e-mail) to:
nasaedutv@smtpgate.osu.hq.nasa.gov

NASA Television features programming that has three program blocks: Education File, History File, and News Video File--repeated at intervals 24 hours a day. Programs feature:

- Space Shuttle mission coverage
- Live special events
- Interactive education videoconferences
- Electronic field trips
- Aviation and space news
- Historical NASA footage

The Education File features programming for teachers and students on science, mathematics, and technology. You and your class can investigate exciting NASA research endeavors in aeronautics, microgravity, planetary sciences, human exploration of space Earth systems, robotics, and more. Educators are welcome to videotape NASA TV. The scheduled times for the Education File are: 2-3 p.m., 5-6 p.m., 8-9 p.m., 11 p.m.-12 a.m., and 2-3 a.m. (EST). For more information, contact:

NASA TV, NASA Headquarters, Code P-2
Washington, DC 20546
Phone (202)358-3572

NASA TV: Spacenet-2, C-Band, T5, Ch. 9,
69 degrees West, 3880 MHz, horizontal
polarization, audio 6.8 MHz

NASA Educator Resource Center Network

To make additional information available to the educational community, the NASA Education Division has created the **NASA Educator Resource Center (ERC) Network**. ERCs contain a wealth of information for educators: publications, reference books, slide sets, audio cassettes, videotapes, telelecture programs, computer programs, curriculum support materials, and educator guides with activities. Because each NASA Field Center has its own areas of expertise, no two ERCs are exactly alike. Telephone calls are welcome if you are unable to visit the ERC that serves your geographic area. A list of the Centers and the geographic regions they serve are listed in the following paragraphs:

Regional Educator Resource Centers (RERCs) offer more educators access to NASA educational materials. NASA has formed partnerships with universities, museums, and other educational institutions to establish RERCs in many states. Educators may preview, copy, or receive NASA materials at these sites. A complete list of RERCs is available through the ERCs or CORE.

NASA Central Operation of Resource for Educators (CORE) was established for the national and international distribution of NASA-produced educational materials in audiovisual format. Educators can obtain a catalogue of these materials and an order form by written request, on school letterhead, to:

NASA CORE
Lorain County Joint Vocational School
15181 Route 58 South
Oberlin, OH 44074
Phone: (216) 774-1051, Ext. 293 or 294

WEB SITE:

Web site for NASA ERCN is:
<http://www.teacherlink.usu.edu/nasa/accessnasa/TRCN.html>

IF YOU LIVE IN:

Alaska	Nevada
Arizona	Oregon
California	Utah
Hawaii	Washington
Idaho	Wyoming
Montana	

Contact:
Mr. Garth A. Hull
Mail Stop 204-12
NASA Ames Research Center
Moffett Field, CA 94035-1000
Phone: (415) 604-5543

NASA Educator Resource Center
Mail Stop T12-A
Moffett Field, CA 94035-1000
Phone: (415) 604-3575

NASA Educator Resource Center Network

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IF YOU LIVE IN:

Connecticut	New Hampshire
Delaware	Pennsylvania
Maine	Rhode Island
Massachusetts	Vermont
Mayland	Washington, DC
New Jersey	
New York	

Contact:

Dr. Robert Gabrys
Code 130
NASA Goddard Space Flight Center
Greenbelt, MD 20771-001
Phone: (301) 286-7206

NASA Educator Resource Laboratory
Mail Code 103.3
Greenbelt, MD 20771-0001
Phone: (301) 286-8570

IF YOU LIVE IN :

Florida	Puerto Rico
Georgia	Virgin Islands

Contact:

Dr. Steve Dutczak
Mail Code PA-EBS
NASA Kennedy Space Center
Kennedy Space Center, FL 32899-0001
Phone: (407) 867-4444

NASA Educators Resource Center
Mail Code ERL
Kennedy Space Center, FL 32899-0001
Phone: (407) 867-4090

IF YOU LIVE IN:

Colorado	North Dakota
Kansas	Oklahoma
Nebraska	South Dakota
New Mexico	Texas

Contact:

Dr. Robert Fitzmaurice
Branch - AP2
2101 NASA Road 1
NASA Johnson Space Center
Houston, TX 77058-3696
Phone: (281) 483-1257

NASA Educator Resource Center
Mail Code AP2
2101 NASA Road 1
Houston, TX 77058-3696
Phone: (281) 483-8696

IF YOU LIVE IN:

Kentucky	Virginia
North Carolina	West Virginia
South Carolina	

Contact:

Dr. Marchelle Canright
Mail Stop 400
NASA Langley Research Center
Hampton, VA 23681-0001
Phone: (757) 864-3313

NASA Educator Resource Center
Virginia Air and Space Center
600 Settlers Landing Road
Hampton, VA 23669-4033
Phone: (757) 727-0900 ext. 757

NASA Educator Resource Center Network

(Continued)

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IF YOU LIVE IN:

Illinois	Minnesota
Indiana	Ohio
Michigan	Wisconsin

Contact:

Ms. JoAnn Charleston
Mail Stop 7-4
NASA Lewis Research Center
21000 Brookpark Road
Cleveland, OH 44135-3191
Phone: (216) 433-2957

NASA Educator Resource Center
Mail Stop 8-1
NASA Lewis Research Center
21000 Brookpark Road
Cleveland, OH 44135-3191
Phone: (216) 433-2017

IF YOU LIVE IN:

Mississippi

Contact:

Dr. David Powe
Manager, Educational Programs
Mail Stop MA00
NASA John C. Stennis Space Center
Stennis Space Center, MS 39529-6000
Phone: (601) 688-1107

NASA Educator Resource Center
Building 1200
NASA John C. Stennis Space Center
Stennis Space Center, MS 39529-6000
Phone: (601) 688-3338

Internet:

The following listing of Internet addresses will provide users with links to URL's related to the NASA Education Home Page and the greenhouse effect.

<http://www.hq.nasa.gov/office/codef/education/>

<http://www.hq.nasa.gov/office/mtpe>

<http://spacelink.msfc.nasa.gov>

<http://www.usra.edu/esse/ESSE.html>

<http://www.globe.gov>

<http://www.ems.psu.edu/~fraser/Bad/BadGreenhouse.html>

<http://www.dar.csiro.au/pub/info/greenhouse.html>

<http://www.eosdis.ornl.gov/educator/eduhome.html>

<http://www.gcrio.org/gwcc/toc.html>

<http://asd.www.larc.nasa.gov/ASDhomepage.html>

<http://eosdis.larc.nasa.gov>

IF YOU LIVE IN:

Alabama	Louisiana
Arkansas	Missouri
Iowa	Tennessee

Contact:

Mr. Jim Pruitt
NASA Marshall Space Flight Center
Huntsville, AL 35812-0001
Phone: (205) 544-8800

NASA Educator Resource Center
U.S. Space and Rocket Center
P.O. Box 070015
Huntsville, AL 35812-0001
Phone: (205) 544-5812

NASA Educational Materials

Lithographs/Bookmarks:

Mission To Planet Earth Green Bookmark
HqL-326 World Cloud Cover Pattern Lithograph
HqL-430 Understanding Our Changing Planet Lithograph
HqL-319 Nimbus - 7 Ocean Ice Maps: Decembers Past Lithograph

Posters:

Earth's Changing Atmosphere (Atlas)

Fact Sheet:

NF-222 Global Warming Fact Sheet
NF-182 The Greenhouse Effect Fact Sheet
Goddard Space Flight Center's Laboratory for Oceans Fact Sheet

Educational Briefs/Educational Topics:

The Living Ocean - Observing Ocean Color from Space
EP-307 The Living Ocean - Teacher's Guide with Activities
PAM-552 Earth Observing System (NASA's Mission To Planet Earth)

To obtain resource materials contact the following:

NASA Educator Resource Center
Virginia Air and Space Center
600 Settlers Landing Road
Hampton, VA 23669-4033
Phone: (757) 727-0900 ext. 757